

Improving conception rates for farms with a milk progesterone sensor

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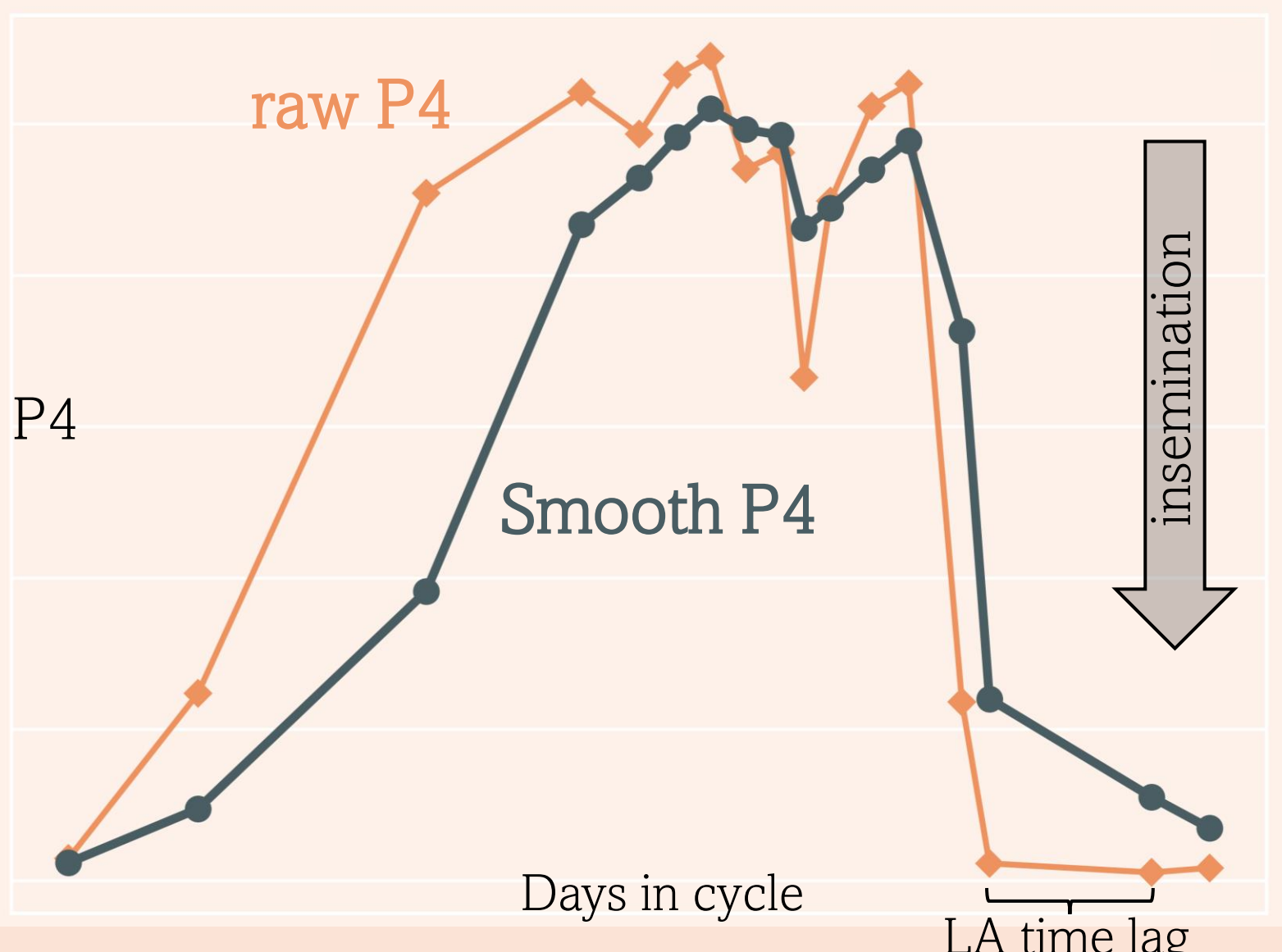
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Introduction

Milk progesterone (P4) can accurately identify an individual dairy cow's reproduction status. On commercial dairy farms, an on-farm P4 device (OPD) monitors **raw** P4 data. To this end, the raw data is **smoothed** and fixed thresholds are used to estimate the time of luteolysis (luteolysis alert (LA)) preceding ovulation. The OPD introduces a time lag on the LA and variation in this time lag is not considered in the estimation of the **optimal insemination window** that is advised to the farmer.



Objectives

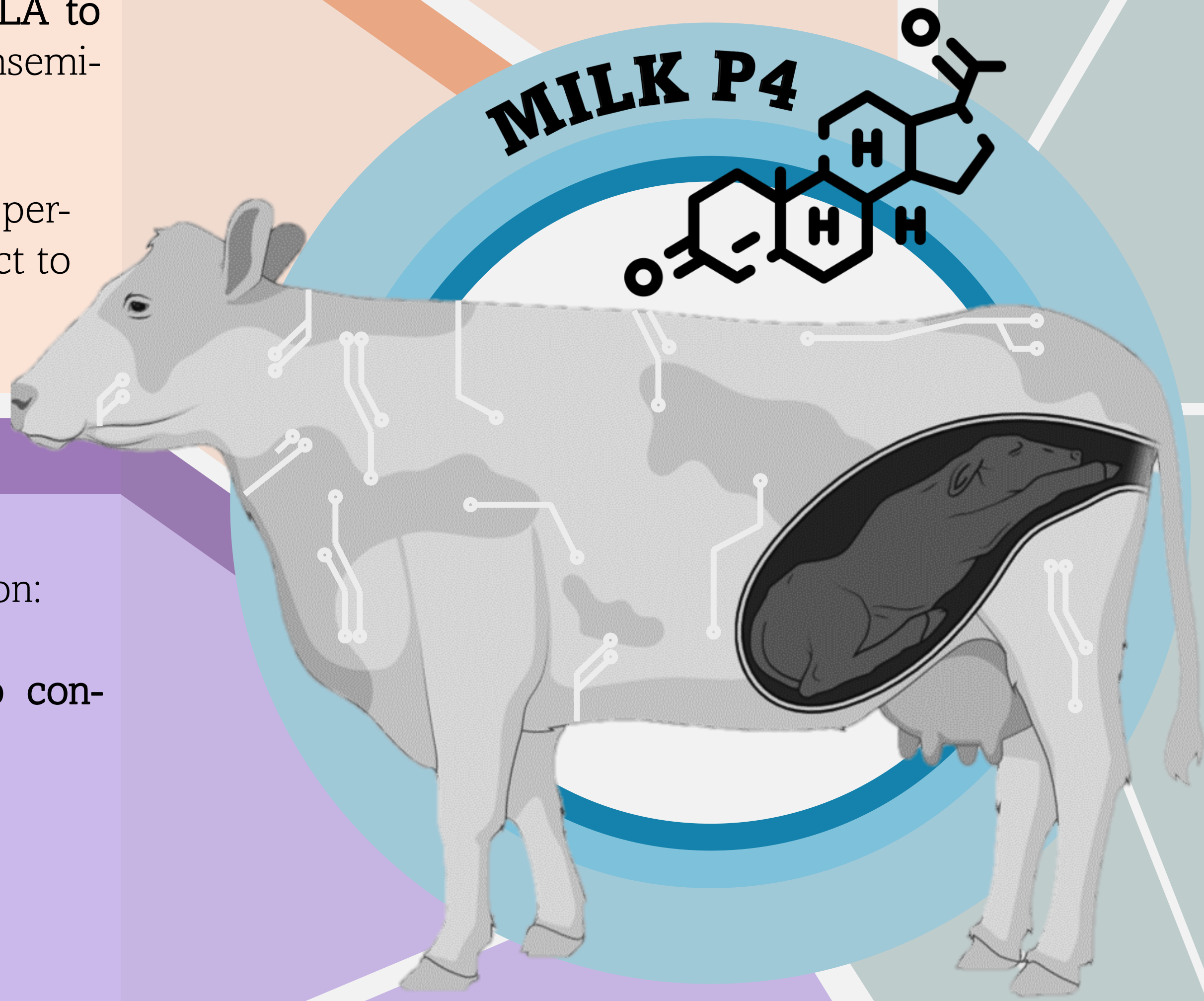
- (1) Estimate LA time lag preceding insemination
- (2) Evaluate LA time lags ↔ interval from LA to insemination for successful and unsuccessful inseminations
- (3) Evaluate conception rates for inseminations performed too early, in time or too late with respect to the advised optimal insemination window → in function of the time lags.

Material & Methods

Data selection

Exclusion of known factors preventing conception:

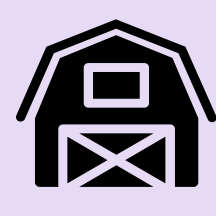
- (1) **Conception**: no luteolysis ≤ 42 d and **no conception**: luteolysis ≤ 24 d after insemination
- (2) Insemination within 4 d before or after LA
- (3) No gaps
- (4) Inter-luteal interval ≤ 12 d



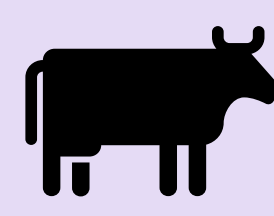
Final dataset

7617 inseminations

17 farms



3214 cows



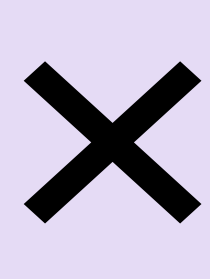
4868 lactations



3721 conception



3896 no conception



Statistical analysis

- (1) **Multivariable mixed effect logistic regression** to investigate the relation LA time lag and the interval from LA to insemination on the binary outcome trait 'Conception'.
- (2) **Multivariable linear regression** to investigate the relation between LA time lag and Conception with interval from LA to inseminations as the dependent variable.
- (3) **Wilcoxon rank-sum test** to compare the interval from LA to insemination between unsuccessful and successful inseminations with an LA time lag < 24 h and ≥ 24 h.
- (4) **Chi-square test and Odds Ratio** to compare conception rates when 'earlier', 'in time' and 'later' than advised in function of LA time lag

Results & Discussion

(1) Multivariable mixed model logistic regression

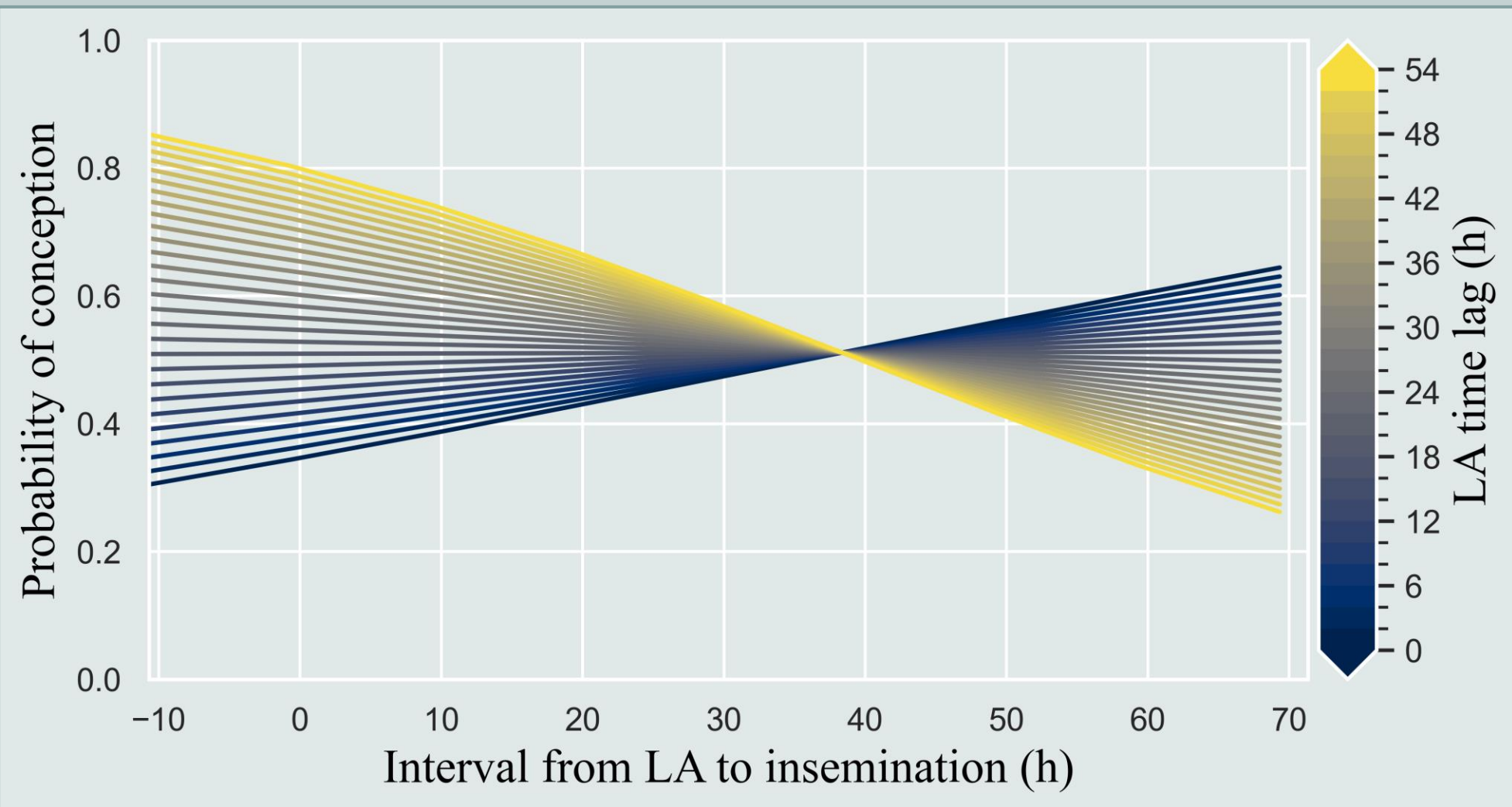


Fig 1. Probability of conception for different values of LA time lag and the interval from LA to insemination

(2) Multivariable linear regression

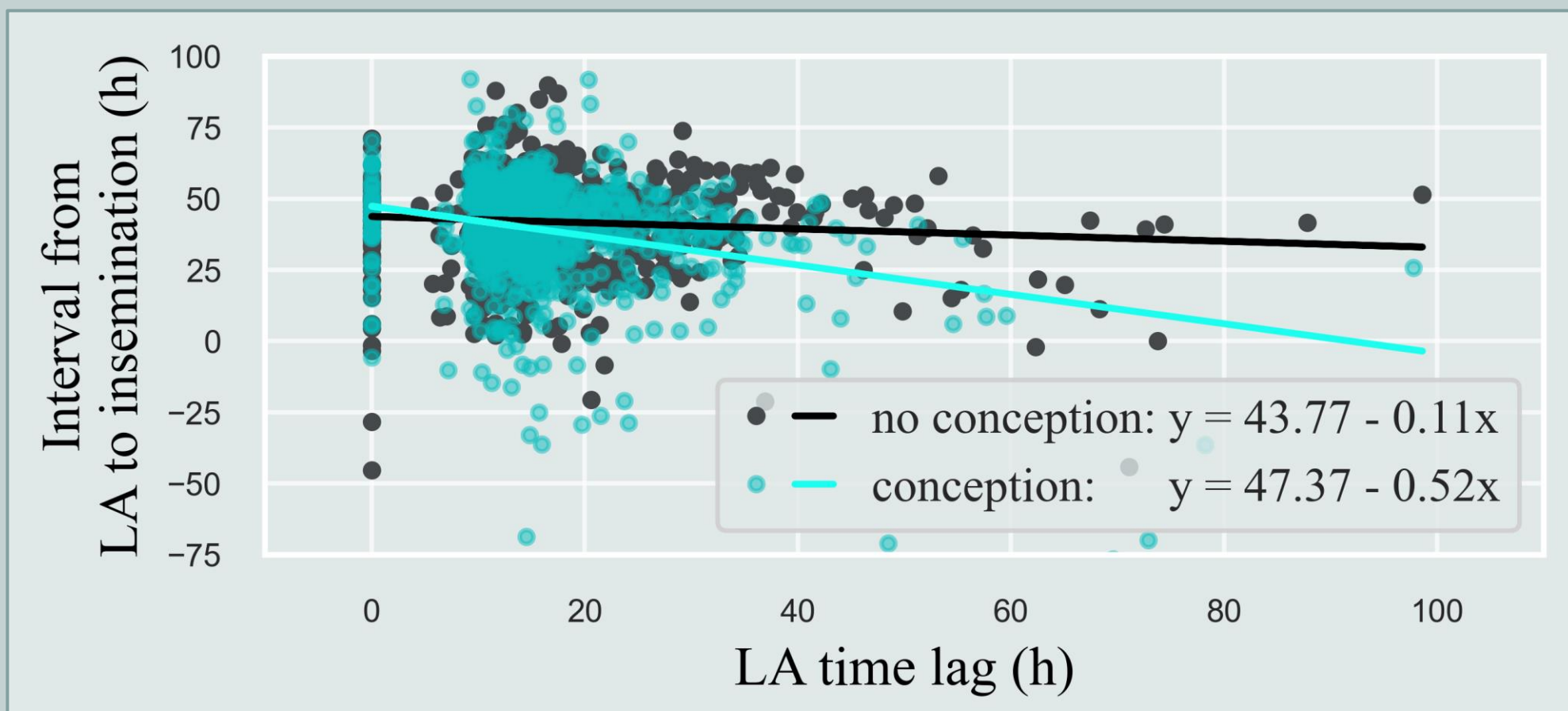


Fig 2. Regression trend between LA time lag and the interval from LA to insemination for no conception and conception

(3) Wilcoxon rank-sum test

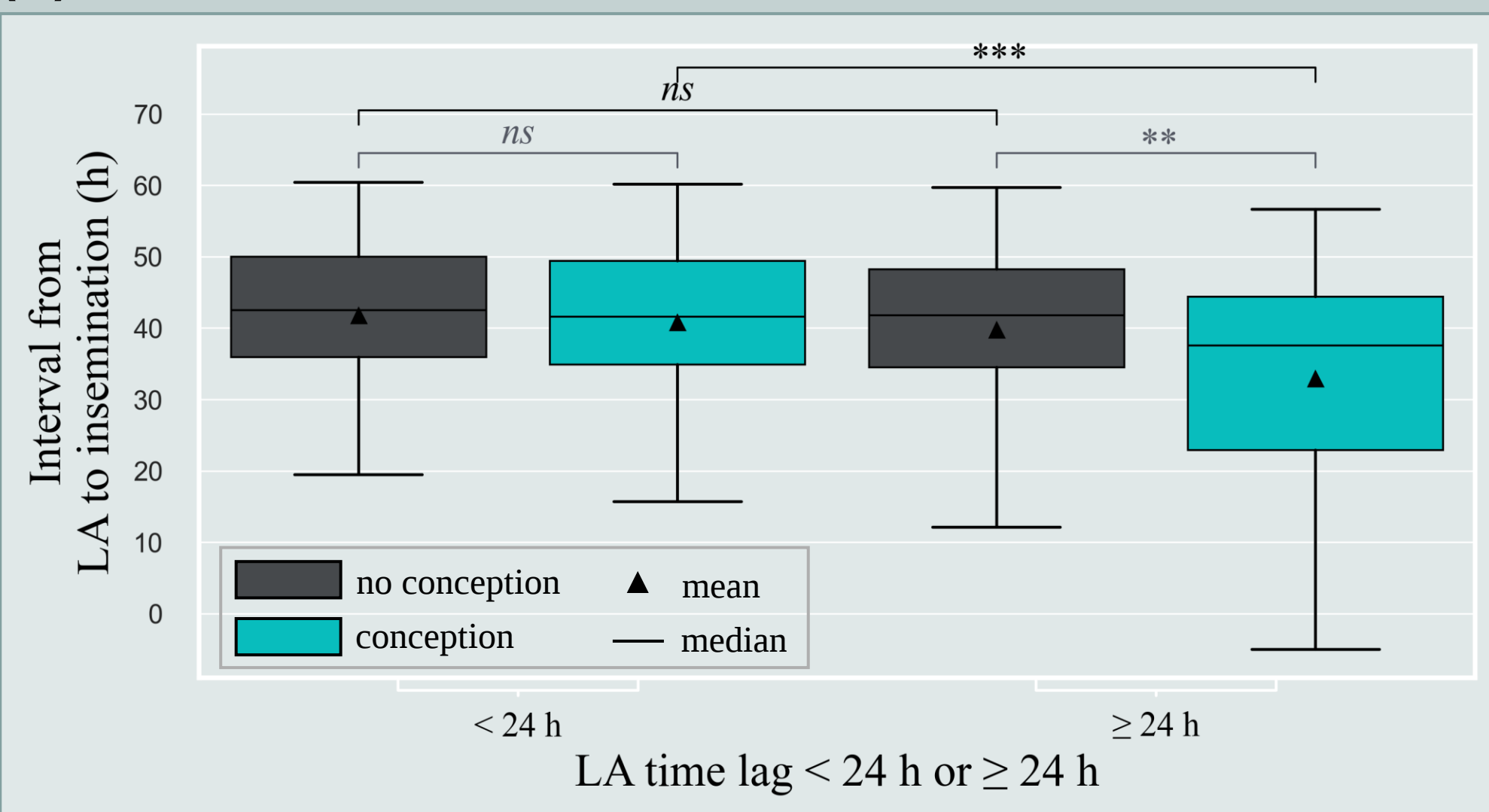


Fig 3. Comparison of the interval from LA to insemination between unsuccessful/successful inseminations and LA time lag < 24 h / ≥ 24 h

(4) Chi-square test and Odds Ratio

Table 1. Percentage of inseminations that resulted in conception. Capital superscript compare within each column and small superscripts within each row.

LA time lag	Inseminated		
	Earlier than advised	As advised	Later than advised
Short (< 8 h)	40.2% ^{Aa} (n = 97)	40.2% ^{Aa} (n = 214)	57.7% ^{Aa} (n = 52)
Standard (≥ 8 h and < 24 h)	53.6% ^{ABa} (n = 801)	49.2% ^{Aa} (n = 4630)	46.1% ^{Aa} (n = 865)
Long (≥ 24 h)	59.0% ^{Bb} (n = 249)	46.0% ^{Aa} (n = 605)	35.6% ^{Aa} (n = 104)

Table 2. OR to compare conception when inseminated earlier than advised, as advised and later than advised for short and long LA time lag

	Short time lag (< 8 h)		Long time lag (≥ 24 h)	
	Odds Ratio		Odds Ratio	
	OR	95% CI	OR	95% CI
earlier than VS as advised	1.00	[0.61 - 1.63]	1.70	[1.26 - 2.29]
later than VS as advised	2.03	[1.10 - 3.75]	0.65	[0.42 - 1.00]
earlier than VS later than advised	0.49	[0.25 - 0.98]	2.61	[1.62 - 4.19]

Conclusions & Application and future research

Conclusions

- Important to **take LA time lag into account** when **estimating the optimal insemination window**, especially when the time lag is long.
- When the **LA time lag increases**, the **probability of conception increases** when the **interval from LA to insemination decreases** and vice versa.
- Clear **negative relationship** between **LA time lag** and **interval from LA to insemination** in **successful inseminations**
- Conception rate is 13% higher** for inseminations performed **earlier than advised** when time lag ≥ 24 h (12.6% of the alerts). **Conception rate is 17.5% higher** for inseminations performed **later than advised** when time lag < 8 h (4.8% of the alerts)



Application and future research

- Information easily available to the farmer → **optimal insemination window tailored** by accounting for the LA time lag → **higher conception rates**.
- Identify inseminations in correct time window → **first step towards future research** on cow and non-cow related factors that could influence fertility